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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:
Buie, et al.

Serial No.: 10/024,958

Confirmation No.: 3439

Filed: December 18, 2001

For: Etch Process Photolithographic Reticle Manufacturing with Improved Etch Bias

§ Group Art Unit: 1765

§ Examiner: Kin-Chan Chen

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
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37 CFR 1.8
I hereby certify that this correspondence is being deposited on October 22, 2004 with the United States Postal Service as First Class Mail in an envelope addressed to: Mail Stop Appeal-Brief – Patents, Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.

October 22, 2004 — Date
Signature

Dear Sir:

APPEAL BRIEF

Appellants submit this Appeal Brief to the Board of Patent Appeals and Interferences on appeal from the decision of the Examiner of Group Art Unit 1765 dated March 18, 2004, rejecting claims 1-24. Please charge the fee of $340.00 for filing this brief and all other fees that may be required to make this Brief timely and acceptable to the Patent Office, to Deposit Account No. 20-0782/4213P1/KMT.

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REAL PARTY IN INTEREST

The real party in interest is Applied Materials, Inc., located in Santa Clara, CA.

RELATED APPEALS AND INTERFERENCES

There are no related Appeals or Interferences with regard to the present application.

STATUS OF CLAIMS

Claims 1-24 are pending in the application. Claims 1-24 were originally presented in the application. Claims 1-24 stand rejected in view of several references as discussed below. The rejection of claims 1-24 based on the cited references is appealed. The pending claims are shown in the attached Claims Appendix.

STATUS OF AMENDMENTS

All amendments have been entered. A response was submitted to the Final Office Action dated March 18, 2003. No amendment to the claims was present in the response to the Final Office Action, which Applicants now Appeal. The arguments set forth in the response to the Final Office Action were considered by the Examiner in an advisory action dated July 6, 2004.

SUMMARY OF CLAIMED SUBJECT MATTER

The present invention provides methods and related chemistry for etching a metal layer deposited on a silicon based substrate, such as a photolithographic reticle. In the embodiment of independent claim 1, a method is provided for processing a photolithographic reticle 300 including positioning the reticle 300 on a support member 16 in a processing chamber 10 (*See,* paragraphs [0020] to [0025]; Fig. 1). The reticle 300 comprises a metal photomask layer 320 formed on a silicon based substrate 310 and a patterned resist material 330 deposited on the metal photomask layer 320 (*See,* paragraphs [0043] to [0050]; Figs. 2 and 3A-3C), introducing a processing gas comprising carbon monoxide and a chlorine containing gas into the processing chamber 10, wherein the carbon monoxide and the chlorine containing gas have a molar ratio between about 1:9 and about 9:1 (*See,* paragraphs [0020] to [0025] and [0027]), and delivering power to the processing chamber 10 to generate a plasma and remove exposed portions of the metal photomask layer 300 (*See,* paragraphs [0045] to [0050]; Fig. 3C).

In the embodiment of independent claim 13, a method is provided for processing a photolithographic reticle 300 including positioning the reticle 300 on a support member 16 in a processing chamber 10 having a coil 26 (*See,* paragraphs [0020] to [0025]; Fig. 1), wherein the reticle 300 comprises a chromium based metal photomask layer 320 formed on an optically transparent silicon based material 310 and a patterned resist material 330 deposited on the chromium based metal photomask layer 320 (*See,* paragraphs [0038] and [0043] to [0050]; Figs. 2 and 3A-3C), introducing a processing gas comprising carbon monoxide and a halogen-containing gas into the processing chamber 10, wherein the carbon monoxide and the chlorine containing gas have a molar ratio between about 1:9 and about 9:1 (*See,* paragraphs [0020] to [0025] and [0027]), introducing an inert gas (*See,* paragraph [0029]), maintaining a chamber pressure between about 2 milliTorr and about 25 milliTorr (*See,* paragraph [0031]), and delivering power to the processing chamber 10 of about 700 watts or less to a coil 26 disposed in the processing chamber 10 to generate a plasma (*See,* paragraph [0033])

and etching exposed portions of the chromium based photomask layer 300 (*See*, paragraphs [0045] to [0050]; Fig. 3C), and selectively removing the chromium based photomask layer at a removal rate ratio of chromium based photomask layer to resist material of about 3:1 or greater (*See*, paragraph [0035]).

In the embodiment of independent claim 20, a method is provided for processing a photolithographic reticle 300 including positioning the reticle 300 on a support member 16 in a processing chamber 10 having a coil 26 (*See*, paragraphs [0020] to [0025]; Fig. 1), wherein the reticle 300 comprises a chromium based metal photomask layer 320 formed on an optically transparent silicon based material 310 and a patterned resist material 330 deposited on the chromium based metal photomask layer 320 (*See*, paragraphs [0038] and [0043] to [0050]; Figs. 2 and 3A-3C), introducing a processing gas comprising carbon monoxide and a halogen-containing gas into the processing chamber 10, wherein the carbon monoxide and the chlorine containing gas have a molar ratio is about 1:1 (*See*, paragraphs [0020] to [0025] and [0027]), and the oxygen-containing gas comprises between about 5% and about 45% of the processing gas, (*See*, paragraph [0028]) introducing helium into the processing chamber 10 (*See*, paragraph [0029]), maintaining a chamber pressure between about 2 milliTorr and about 25 milliTorr (*See*, paragraph [0031]), generating a plasma in the processing chamber 10 to (*See*, paragraph [0033]) and etching exposed portions of the chromium based photomask layer 300 (*See*, paragraphs [0045] to [0050]; Fig. 3C), and selectively removing the chromium based photomask layer at a removal rate ratio of chromium based photomask layer to resist material of about 3:1 or greater (*See*, paragraph [0035]).

GROUNDS OF REJECTION

1. Claims 1-24 stand rejected under 35 U.S.C. §103(a) as being obvious over *Kornblit et al.* (U.S. Patent No. 5,948,570, hereinafter "*Kornblit*") in view of *Meyer et al.* (U.S. Patent No. 4,600,686, hereinafter "*Meyer*"). *Yasuzato et al.*, (U.S. Patent No. 5,750,290, hereinafter "*Yasuzato*") is in the record as evidence.

THE REFERENCES

The Examiner relies on the following references:

Author	Publication Title or Reference number	Publication Date
Kornblit et al.	U.S. Patent No. 5,948,570	September 7, 1999
Meyer et al.	U.S. Patent No. 4,600,686	July 15, 1986
Of Record: *Yasuzato et al.*	U.S. Patent No. 5,750,290	May 12, 1998

BRIEF DESCRIPTION OF THE REFERENCES

Kornblit et al. discloses etching a chromium layer with a gaseous mixture of oxygen gas, chlorine gas, and nitrogen as etchant species, in combination with a patterned organometallic resist. (*See,* Abstract, col. 2, lines 44-56, col. 4, lines 10-24) *Kornblit et al.* discloses that nitrogen is used in the etchant chemistry to dilute the oxygen gas and chlorine gas chemistry to minimize undercutting of the chromium layer and provide a more anisotropic etch pattern. (*See,* col. 4, lines 24-33) *Kornblit et al.* discloses the use of oxygen gas and chlorine gas as specific etchant specie, and nitrogen gas to dilute the etchant specie.

Meyer et al. discloses depositing a chromium layer, depositing and patterning a photoresist, forming an etch resistant skin with a second chromium layer disposed over

the patterned photoresist, baking the substrate so that the chromium reacts with the photoresist, and etching the unreacted chromium. (*See,* Abstract, col. 2, lines 38-67, Figs. 1 and 2) *Meyer et al.* disclose etchant species of carbontetrachloride (CCl_4) and oxygen gas. *Meyer et al.* further disclose carrier gases of argon and carbon monoxide. (*See,* col. 3, lines 3-16)

The reference of record, *Yasuzato*, and not used in the rejection, discloses chromium etching with a gas containing chloride (*See,* col. 2, lines 12-15, col. 8, lines 59-62)

ARGUMENT

THE ISSUES UNDER 35 U.S.C. §103

THE EXAMINER ERRED IN REJECTING CLAIMS 1-24 UNDER 35 U.S.C. §103 BECAUSE THE COMBINATION OF *KORNBLIT* IN VIEW OF *MEYER* DOES NOT TEACH, SHOW, OR SUGGEST ETCHING A METAL, CHROMIUM, LAYER WITH CARBON MONOXIDE AND CHLORINE GAS.

Applicants respectfully disagree with the Examiner's conclusions regarding the patentability of claims 1-24 over *Kornblit* in view of *Meyer*. In particular, there is no motivation or suggestion to combine *Kornblit* in view of *Meyer* in a manner that teaches or suggests all of the limitations recited by claims 1-24. Additionally, the Applicants respectfully disagree with the Examiner's conclusions regarding the presence of etching gas constituents, ratio of etching gases, and process parameters may be determined by routine experimentation.

Primarily, the Appellants submit that there is no motivation or suggestion for combining select processing gases in *Kornblit* with select processing gases of *Meyer* in a manner that would yield the gases and gas ratios of the claimed invention. *Kornblit.* discloses the use of oxygen gas and chlorine gas as specific etchant specie, and describes as critical, the use of nitrogen gas to dilute the etchant specie and to minimize undercut of chromium material being etched. *Kornblit* does not suggest or motivate the use of a carbon containing compound, such as carbon monoxide in etching a chromium layer, which carbon monoxide may form passivating deposits during an etching process to limit undercutting of a chromium layer as disclosed in the present invention. In fact, the critical use of nitrogen specifically in combination with chlorine and oxygen in *Kornblit* teaches away from the use other compounds, such as carbon monoxide recited in claims 1-24.

By contrast, *Meyer* discloses that the chromium disposed on a photoresists material may be etched in a plasma containing one (1) part carbontetrachloride (CCl_4) and one (1) part oxygen in three parts carrier gases, such as argon and carbon monoxide. *Meyer* discloses the critical use of carbontetrachloride (CCl_4) and oxygen in

the etching composition and *Meyer* does not disclose that the carrier gas is critical beyond its presence, whether an inert gas or carbon monoxide. *Meyer* does not suggest or motivate the combination of carbon monoxide and chlorine gas as etchant species in etching a chromium layer.

The is also no suggestion or motivation in the combined references to combine the nitrogen dilutant etchant chemistry of *Kornblit* with the carbontetrachloride (CCl_4) and oxygen etching gas of *Meyer.* Thus, the combined references do not teach, show, or suggest the method and composition as recited in claims 1-24.

Further in a reference of record, *Yasuzato*, not used to reject the pending claims, the Examiner asserts that *Yasuzato* shows similarity of using chlorine containing gases. *Yasuzato* discloses chromium etching with a gas containing chloride, such as CCl_4 and Cl_2. Applicants disclose chlorine gas and do not disclose CCl_4. The Examiner implies that the list of gas containing chloride and the Applicants list suggest or motivate interchangeability of chlorine gases. Applicants disagree with the Examiner's assertion on ground that *Yasuzato* is being used in hindsight to rationalize picking and choosing selective gases from the *Kornblit* and *Meyer* processing gases. Applicants respectfully disagree with the Examiner's reasoning regarding *Yasuzato* similarity of chlorine containing gases to overcome the lack of suggestion or motivation in *Kornblit* and *Meyer* to teach the subject matter as recited in claims 1-24.

Thus, there is no suggestion or motivation to selectively choose individual etchants from *Kornblit* and *Meyer* to form an etching gas; and the combination of *Kornblit* and *Meyer* does not teach, show, or suggest etching a chromium layer with carbon monoxide and chlorine gas. *Yasuzato,* alone or in combination with *Kornblit* and *Meyer*, does not suggest or motivate the combination of carbon monoxide and chlorine gas as etchant species in etching a chromium layer.

Further, due to the lack of suggestion or motivation to combine the references to teach the etching gases as recited in claims 1-24, there is no suggestion or motivation to allow determination of the ratio of etching gases and process parameters by routine experimentation.

MPEP §2141.03 requires the Examiner to consider the prior art in its entirety. "A prior art reference must be considered in its entirety, *i.e.*, as a whole, including portions

that would lead away from the claimed invention". MPEP §2141.03, *W.L. Gore & Associates, Inc., v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed Cir. 1983), cert. denied, 469 U.S. 851 (1984). The Examiner has not considered either *Kornblit* or *Meyer* as a whole, because there is no motivation to combine the etching compositions taught by *Kornblit* and *Meyer*. Therefore, there is no motivation to combine *Kornblit* and *Meyer* in a manner that would yield the claimed invention.

By alleging that the Appellants' invention is taught by a combination of *Kornblit* and *Meyer*, with reference to *Yasuzato*, the Examiner is clearly using hindsight to pick and choose elements from the references to support his rejection. It is impermissible to use the claims as a framework from which to choose among individual references to recreate the claimed invention. *W. L. Gore Associates, Inc. v. Garlock, Inc.*, 220 U.S.P.Q. 303, 312 (1983). Moreover, the mere fact that a prior art structure could be modified to produce the claimed invention would not have made the modification obvious unless the prior art suggested the desirability of the modification. *In re Fritch*, 23 U.S.P.Q. 2d 1780, 1783, Fed. Cir. (1992); *In re Gordon*, 221 U.S.P.Q. 1125, 1127, Fed. Cir. (1984) (emphasis added). The rules applicable for combining references provide that there must be a suggestion from within the references to make the combination. *Uniroyal v. Rudkin-Wiley*, 5 U.S.P.Q. 2d 1434, 1438 (Fed. Cir. 1988); *In re Fine*, 5 U.S.P.Q. 2d at 1599 (emphasis added). Therefore, there is no justification for combining *Kornblit* and *Meyer* in a manner that obviates the claimed invention.

The burden for establishing a prima facie case of obviousness falls on the Examiner. *See, MPEP* §2142. A basic requirement of establishing a prima facie case of obviousness is that the combination of prior art references must teach or suggest all the claim limitations and that there must be a motivation to combine the references. *See, MPEP* §2143.

The Examiner has failed to establish a prima facie case because there is no motivation to combine *Kornblit* and *Meyer* in a manner to teach, show or suggest etching a chromium layer with carbon monoxide and chlorine gas, as claimed by Appellants. The Examiner is using hindsight to employ the claimed invention as a framework to select elements from two divergent teachings. As such, the Examiner fails to properly show that the combination of *Kornblit* and *Meyer* teaches, shows or

suggests all of the features required to sustain the Examiner's rejection under 35 U.S.C. §103 of the Appellants' claimed invention.

Therefore, the combination of *Kornblit* and *Meyer* does not teach, show, or suggest positioning the reticle on a support member in a processing chamber, wherein the reticle comprises a metal photomask layer formed on a silicon based substrate and a patterned resist material deposited on the metal photomask layer, introducing a processing gas comprising carbon monoxide and chlorine gas into the processing chamber, wherein the carbon monoxide and the chlorine gas have a molar ratio between about 1:9 and about 9:1, and delivering power to the processing chamber to generate a plasma and remove exposed portions of the metal photomask layer, as recited in claim 1, and claims dependent thereon.

Thus, at least for the reasons stated above, claim 1, and claims dependent therefrom, are patentable over *Kornblit* in view of *Meyer*. Therefore, the Appellants submit that claim 1, and claims dependent therefrom, as they now stand, fully satisfy the requirements of 35 U.S.C. §103 and are patentable thereunder.

The combination of *Kornblit* and *Meyer* does not teach, show, or suggest positioning the reticle on a support member in a processing chamber, wherein the reticle comprises a chromium based photomask layer formed on an optically transparent silicon based material and a patterned resist material deposited on the chromium based photomask layer, introducing a processing gas comprising carbon monoxide and chlorine gas, wherein the molar ratio between carbon monoxide and chlorine gas is about 1:1, introducing an inert gas, maintaining a chamber pressure between about 2 milliTorr and about 25 milliTorr, delivering power to the processing chamber of about 700 watts or less to a coil disposed in the processing chamber to generate a plasma, and etching exposed portions of the chromium based photomask layer and selectively removing the chromium based photomask layer at a removal rate ratio of chromium based photomask layer to resist material of about 3:1 or greater, as recited in claim 13, and claims dependent thereon.

Thus, at least for the reasons stated above, claim 13, and claims dependent therefrom, are patentable over *Kornblit* in view of *Meyer*. Therefore, the Appellants

submit that claim 13, and claims dependent therefrom, as they now stand, fully satisfy the requirements of 35 U.S.C. §103 and are patentable thereunder.

The combination of *Kornblit* and *Meyer* does not teach, show, or suggest positioning the reticle on a support member in a processing chamber having a coil, wherein the reticle comprises a chromium based photomask layer formed on an optically transparent silicon based material and a patterned resist material deposited on the chromium based photomask layer, introducing a processing gas comprising carbon monoxide, chlorine gas, and an oxygen-containing gas into the processing chamber, wherein the molar ratio between carbon monoxide and chlorine gas is about 1:1, and the oxygen-containing gas comprises between about 5% and about 45% of the processing gas, introducing helium into the processing chamber, generating a plasma in the processing chamber, and etching exposed portions of the chromium based photomask layer and selectively removing the chromium based photomask layer at a removal rate ratio of chromium based photomask layer to resist material of about 3:1 or greater, as recited in claim 20, and claims dependent thereon.

Thus, at least for the reasons stated above, claim 20, and claims dependent therefrom, are patentable over *Kornblit* in view of *Meyer*. Therefore, the Appellants submit that claim 20, and claims dependent therefrom, as they now stand, fully satisfy the requirements of 35 U.S.C. §103 and are patentable thereunder.

CONCLUSION

For the reasons advanced above, Appellants respectfully urge that the rejections of claims 1-24 as being unpatentable under 35 U.S.C. §102 and 35 U.S.C. §103 are improper. Reversal of the rejections in this appeal is respectfully requested.

If necessary, please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 20-0782/4213P1/KMT, and please credit any excess fees to the above referenced deposit account.

Respectfully submitted,

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CLAIMS APPENDIX

1. (Previously Presented) A method for processing a photolithographic reticle, comprising:

positioning the reticle on a support member in a processing chamber, wherein the reticle comprises a metal photomask layer formed on a silicon based substrate and a patterned resist material deposited on the metal photomask layer;

introducing a processing gas comprising carbon monoxide and chlorine gas into the processing chamber, wherein the carbon monoxide and the chlorine gas have a molar ratio between about 1:9 and about 9:1; and

delivering power to the processing chamber to generate a plasma and remove exposed portions of the metal photomask layer.

2. (Original) The method of claim 1, wherein the metal photomask layer comprises chromium, chromium oxynitride, or combinations thereof.

3. (Previously Presented) The method of claim 1, wherein the silicon based substrate comprises an optically transparent silicon based material selected from the group consisting of quartz, molybdenum silicide, molybdenum silicon oxynitride, and combinations thereof.

4. (Previously Presented) The method of claim 11, wherein the oxygen containing gas is selected from the group consisting of oxygen (O_2), carbon dioxide (CO_2), and combinations thereof.

5. (Previously Presented) The method of claim 1, wherein the processing gas further comprises an inert gas selected from the group consisting of helium, argon, xenon, neon, krypton, and combinations thereof.

6. (Previously Presented) The method of claim 1, wherein the processing gas further comprises a chlorine containing gas selected from the group consisting of silicon tetrachloride ($SiCl_4$), boron trichloride (BCl_3), and combinations thereof.

7. (Previously Presented) The method of claim 1, wherein the carbon monoxide and the chlorine gas have a molar ratio of about 1:1.

8. (Original) The method of claim 1, wherein the metal photomask layer and the resist material are removed at a removal rate ratio of metal photomask layer to resist material of about 3:1 or greater.

9. (Original) The method of claim 1, wherein processing the reticle comprises introducing the processing gas into a processing chamber, maintaining the processing chamber at a pressure between about 2 milliTorr and about 25 milliTorr, maintaining the reticle at a temperature between about 50°C and about 150°C, and generating a plasma by supplying a source RF power between about 250 Watts and about 700 Watts to a coil to the processing chamber.

10. (Original) The method of claim 9, further comprising applying a bias power to the support member of about 50 Watts or less.

11. (Previously Presented) The method of claim 1, further comprising introducing an oxygen containing gas into the processing gas during etching of the metal layer.

12. (Original) The method of claim 11, wherein oxygen is added to the processing gas and comprises between about 5% and about 45% of the processing gas.

13. (Original) A method for processing a photolithographic reticle, comprising:

positioning the reticle on a support member in a processing chamber, wherein the reticle comprises a chromium based photomask layer formed on an optically

transparent silicon based material and a patterned resist material deposited on the chromium based photomask layer;

introducing a processing gas comprising carbon monoxide and chlorine gas, wherein the molar ratio between carbon monoxide and chlorine gas is about 1:1;

introducing an inert gas;

maintaining a chamber pressure between about 2 milliTorr and about 25 milliTorr;

delivering power to the processing chamber of about 700 watts or less to a coil disposed in the processing chamber to generate a plasma; and

etching exposed portions of the chromium based photomask layer and selectively removing the chromium based photomask layer at a removal rate ratio of chromium based photomask layer to resist material of about 3:1 or greater.

14. (Original) The method of claim 13, wherein the chromium based photomask layer comprises chromium, chromium oxynitride, or combinations thereof, and the optically transparent silicon based material comprises quartz, molybdenum silicide, molybdenum silicon oxynitride, or combinations thereof.

15. (Previously Presented) The method of claim 13, wherein the inert gas is selected from the group consisting of helium, argon, xenon, neon, krypton, and combinations thereof.

16. (Original) The method of claim 13, wherein etching the reticle comprises introducing carbon monoxide (CO), chlorine (Cl_2), and helium, into a processing chamber, maintaining the processing chamber at a pressure between about 5 milliTorr and about 20 milliTorr, maintaining the reticle at a temperature between about 50°C and about 150°C, and generating a plasma by supplying a source RF power between about 250 Watts and about 700 Watts to the processing chamber.

17. (Original) The method of claim 16, further comprising applying a bias power to the support member of about 50 Watts or less.

18. (Original) The method of claim 13, further comprising increasing the oxygen content of the processing gas during etching of the chromium based photomask layer by introducing an oxygen containing gas to comprise between about 5% and about 45% of the processing gas.

19. (Original) The method of claim 15, wherein the resist material and chromium based photomask layer are removed at a removal rate ratio of chromium based photomask layer to resist of about 7:1 or greater.

20. (Original) A method for processing a photolithographic reticle, comprising:

positioning the reticle on a support member in a processing chamber having a coil, wherein the reticle comprises a chromium based photomask layer formed on an optically transparent silicon based material and a patterned resist material deposited on the chromium based photomask layer;

introducing a processing gas comprising carbon monoxide, chlorine gas, and an oxygen-containing gas into the processing chamber, wherein the molar ratio between carbon monoxide and chlorine gas is about 1:1, and the oxygen-containing gas comprises between about 5% and about 45% of the processing gas;

introducing helium into the processing chamber;

generating a plasma in the processing chamber; and

etching exposed portions of the chromium based photomask layer and selectively removing the chromium based photomask layer at a removal rate ratio of chromium based photomask layer to resist material of about 3:1 or greater.

21. (Original) The method of claim 20, wherein the chromium based photomask layer comprises chromium, chromium oxynitride, or combinations thereof.

22. (Previously Presented) The method of claim 20, wherein the oxygen containing gas is selected from the group consisting of oxygen (O_2), carbon dioxide (CO_2), and combinations thereof.

23. (Original) The method of claim 20, wherein processing the reticle comprises introducing the processing gas into the processing chamber, maintaining the processing chamber at a pressure between about 2 milliTorr and about 25 milliTorr, maintaining the reticle at a temperature between about 50°C and about 150°C, generating a plasma by supplying a source RF power between about 250 Watts and about 700 Watts to a coil to the processing chamber, and supplying a bias power to the support member of about 50 Watts or less.

24. (Original) The method of claim 20, wherein the resist material and chromium based photomask layer are removed at a removal rate ratio of chromium based photomask layer to resist of about 7:1 or greater.

EVIDENCE APPENDIX

NO EVIDENCE SUBMITTED

RELATED APPEALS AND INTERFERENCES APPENDIX

NONE